EPA
United States
Environmental Protection
Agency

EPA AND PORT EVERGLADES PARTNERSHIP:

Emission Inventories and Reduction Strategies

Executive Summary

Office of Transportation Air Quality
EPA-420-S-18-002
June 2018

Note: This document contains the Executive Summary of the *EPA and Port Everglades Partnership: Emission Inventories and Reduction Strategies*. The full report can be accessed at: https://www.epa.gov/ports-initiative.

Introduction

Ports are key to the United States economy and serve as gateways to transport cargo, fuel, and passengers around the globe. Seaport cargo activity alone accounts for over a quarter of the U.S. Gross Domestic Product and supports the employment of over 23 million Americans.[1] As part of its Ports Initiative, the U.S. Environmental Protection Agency (EPA) recognizes the importance of working closely with ports to understand the on-the-ground, day-to-day operations and examine the methods available to estimate associated air pollution emissions.[2]

In 2016, EPA's Office of Transportation and Air Quality and Broward County's Port Everglades announced a voluntary partnership to study mobile source emissions.[3] Port Everglades is the first port to partner with EPA in this way. Port Everglades is one of the nation's leading container ports, South Florida's main seaport for receiving petroleum products, and one of the busiest cruise ports in the world.[4] Port Everglades is located in an area that currently meets EPA's national ambient air quality standards, and the Port is committed to environmental stewardship now and in the future.

Port Everglades Passenger Terminal
(Source: Port Everglades)

[1] American Association of Port Authorities (AAPA), http://www.aapa-ports.org/advocating/content.aspx?ItemNumber=21150.

[2] For more information on EPA's Ports Initiative, see https://www.epa.gov/ports-initiative.

[3] For further information on the EPA-Port Everglades Partnership, see https://www.epa.gov/ports-initiative/epa-partnership-agreement-broward-countys-port-everglades.

[4] For further information on Port Everglades, see http://www.porteverglades.net.

Through this partnership, Port Everglades developed the *2015 Baseline Air Emissions Inventory*,[5] which presents port-related emissions based on 2015 activity levels at Port Everglades that can be used as a benchmark to measure the impact of future port changes. The baseline inventory was also used in EPA's development of future hypothetical emission inventories and scenarios to evaluate potential new strategies to reduce diesel emissions at Port Everglades. Diesel engines are important components of the American economy, and although they can be reliable and efficient, older diesel engines can emit significant amounts of air pollution, including particulate matter (PM) and nitrogen oxides (NOx). Emission sources that were considered in this partnership included ocean going vessels, harbor craft, cargo handling equipment, trucks, and locomotives. EPA also evaluated the current and future emissions and potential strategies for three "off-port" transportation corridors—a marine corridor, truck corridor, and rail corridor—for port-related traffic outside the Port.

This partnership will help EPA provide future methods, lessons learned, and practical examples that can be shared with other ports, related agencies, and stakeholders. The findings from this partnership will inform EPA's update to the Port Emissions Inventory Guidance, so that other U.S. ports, port-related industry, state and local governments, tribes, and surrounding communities have clear technical guidance to estimate and understand emission inventories and potential reductions from port-related strategies. This future guidance update was included in stakeholder recommendations from the Mobile Sources Technical Review Subcommittee of the Clean Air Act Advisory Committee.[6]

This report provides valuable information for Port Everglades and its stakeholders to consider and can inform other ports of the full range of strategies available for reducing port emissions. However, it is not a policy document and does not include policy recommendations for Port Everglades. The emission reduction scenarios are hypothetical, and although EPA considered several general factors in its analysis, the scenario results do not consider the logistics and costs for implementation. Additionally, some strategies that were considered are beyond the port's jurisdictional authority to implement.

Key findings of the Port Everglades Partnership are explored in further detail below.

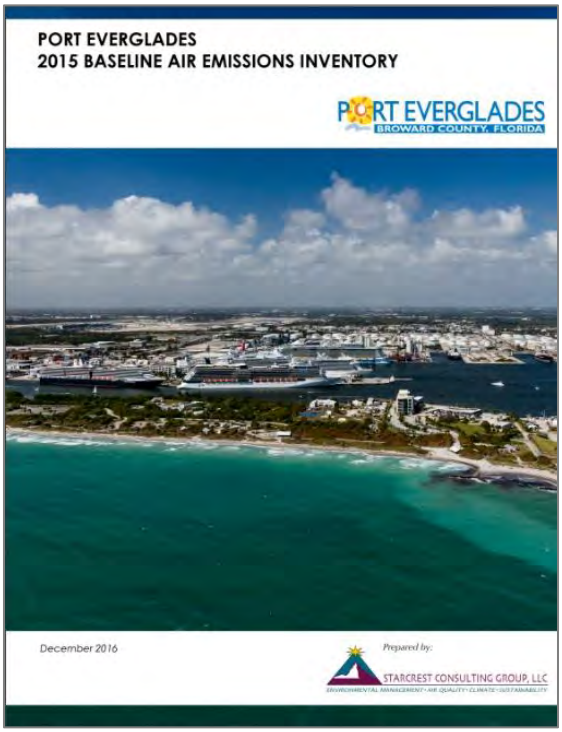
[5] Starcrest Consulting Group, LLC, *Port Everglades 2015 Baseline Air Emissions Inventory*, December 2016 http://www.porteverglades.net/environment/air-quality/air-emissions-inventory.

[6] For further information on the "Final Ports Initiative Workgroup Report: Recommendations for the U.S. EPA," see: https://www.epa.gov/caaac/final-ports-initiative-workgroup-report-recommendations-us-epa.

Partnering with Port Everglades was key to developing methods and lessons learned that can be applied at other ports

Through the partnership, EPA and Port Everglades worked together on common environmental objectives and shared their perspectives. Port Everglades' leadership helped EPA better understand port operations and allowed EPA to use the Port as a technical training ground.[7] The partnership also supported the Port's overall environmental mission and commitment to environmental stewardship.[8] The Port has invested significantly in cleaner equipment (such as electric cranes), and has also supported other improvements to enhance operations (such as reducing on-port truck bottlenecks).

Port Everglades developed the *2015 Baseline Air Emissions Inventory* that identifies and quantifies pollutants emitted from port-related mobile vehicles and equipment operating within the Port. This work guided EPA's development of future year emission reduction scenarios. Additionally, Port Everglades leveraged existing relationships with partners, regional and state agencies, and others to access non-confidential data not readily accessible to EPA,[9] which allowed EPA to refine its analysis. This general experience will inform future EPA guidance.



Port Everglades 2015 Baseline Air Emissions Inventory
(Source: Starcrest Consulting Group)

Through its collaboration with Port Everglades, EPA can cite practical examples, methods, and lessons learned with respect to the development of port-specific inventories and evaluation of emission reduction strategies that can be shared with other ports, related agencies, and stakeholders across the United States. This ultimately provides Port Everglades with a strong technical foundation to make informed decisions with more accurate data, allowing the Port to continue to support clean air, and meet the needs of its customers, stakeholders, and community. The lessons learned through EPA's analysis can be applied to other interested ports.

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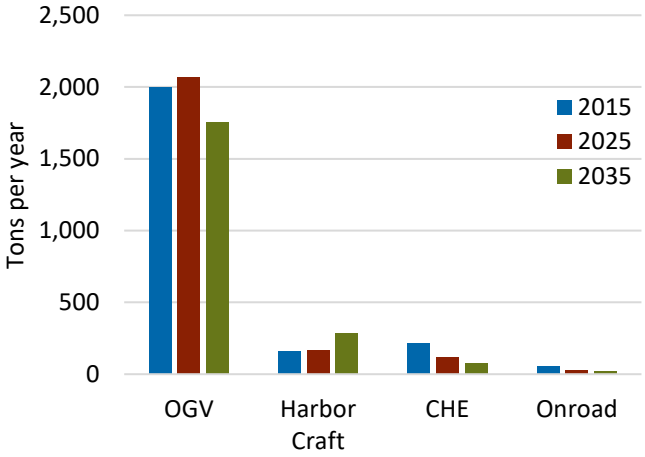
7 Neugaard, E. and Buchan, P., "Port Everglades: A Framework for Cooperation with the EPA," *Journal of Ports and Terminals*, Ed. 75, Autumn 2017.

8 Port Everglades, "About Us—Mission Statement," http://www.porteverglades.net/about-us.

9 EPA did not receive any confidential business or terminal-specific information through the partnership.

Inventories can help benchmark port and port industry progress

An emissions inventory is an important benchmark against which to measure progress and enables informed decision making. The *Port Everglades 2015 Baseline Air Emissions Inventory* was developed from detailed local mobile source activity and fleet information, including ocean going vessels (OGVs), harbor craft, cargo handling equipment (CHE), onroad vehicles, and rail operations. EPA used growth projections from Port Everglades' *2014 Master/Vision Plan*[10] and fleet turnover rates to produce hypothetical Business as Usual (BAU) emission inventories for multiple pollutants for the years 2025 and 2035, with a limited analysis for 2050.[11] Figure ES-1 depicts the baseline and projected BAU inventories for on-port NOx emissions. OGVs are the biggest source of emissions and are expected to remain so in future years, despite the Emission Control Area emission requirements, while projected increases in activity will drive increases in harbor craft emissions.



Note: NOx on-port rail emissions are <2 tons per year.

Figure ES-1. Port Everglades Baseline and Projected BAU On-port NOx Emissions

With these inventories, Port Everglades can now examine emission trends by source, identify potential opportunities for emission reductions, and prioritize future investment or operational changes to reduce emissions. For example, the equipment inventory revealed that harbor craft are aging (Figure ES-2), presenting an opportunity to reduce emissions significantly through incentives to encourage vessel or engine replacement. The Port anticipates conducting additional inventories in the future to benchmark air emissions and track progress.[12]

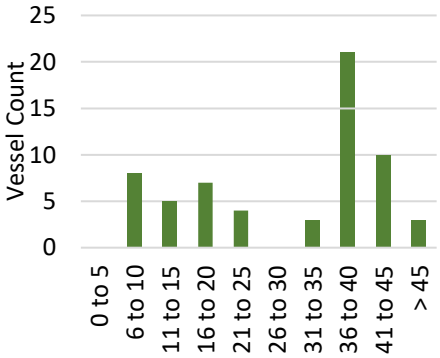


Figure ES-2. Harbor Craft Age Distribution (Years Old)

[10] Port Everglades, *2014 Master/Vision Plan* reports, June 24, 2014, http://www.porteverglades.net/construction/master-vision-plan/master-plan-reports.

[11] EPA's analysis included criteria pollutants and precursors (e.g., PM and NOx), greenhouse gases, and air toxics (i.e., diesel PM). All pollutants were analyzed for the years 2025 and 2035, and for 2050, carbon dioxide equivalents (CO_2e) were analyzed. For the full set of assumptions used to generate emission inventories and projections, see the main report.

[12] Neugaard, E. and P. Buchan, "Port Everglades: A Framework for Cooperation with the EPA," *Journal of Ports and Terminals*, Ed. 75, Autumn 2017.

Emissions are being reduced, but more can be done with available strategies

The BAU inventories show that EPA's engine and fuel regulations, as well as emerging commercially available technologies, are expected to reduce port-related emissions. For example, new vehicle and equipment emission standards are already reducing NOx and PM emission rates as older equipment is replaced at ports across the country. However, voluntarily implementing operational strategies or accelerating equipment replacement rates, for example, could further reduce emissions, or reduce emissions sooner. In consultation with Port Everglades, EPA identified voluntary strategies, listed in Table ES-1, to analyze for additional reductions beyond the BAU case.

Table ES-1. On-port Strategies Considered at Port Everglades

Sector	Strategy Descriptions
Ocean Going Vessels	• Reduced hotelling time • At-berth alternative control technology (capture and treat) • Lower sulfur fuels and alternative fuels like liquefied natural gas (LNG) • Shore power
Harbor Craft	• Engine replacement (to Tier 3) and vessel replacement (to Tier 4)
Cargo Handling Equipment	• Equipment replacement (to Tier 4) and equipment electrification • Diesel particulate filters and oxidation catalysts
Onroad	• Truck replacement to MY2010+ and battery electric vehicles (BEVs) • Truck idle reduction
Rail[13]	• Increase modal shift of cargo from truck to rail

Many of these strategies are applicable to any port, but the emission-reducing potential of a given strategy highly depends on a port's individual characteristics. Attributes such as the port's primary activity type and level; types of vessels, equipment, and fuels used; and the technologies and operations utilized onsite impact the emissions reduction potential of a given strategy. In addition to supporting environmental goals, some strategies have potential co-benefits, such as reducing fuel usage and improving operational efficiencies that may enhance a port's competitiveness.

[13] Replacing older diesel locomotives, such as switchers, is an effective emission reduction strategy to consider. However, at Port Everglades, the Florida East Coast Railway has already updated its line-haul locomotive fleet to cleaner technology and has constructed the Intermodal Container Transfer Facility, which does not use switcher locomotives, at the Port. For further general information about other rail strategies, see EPA's *National Port Strategy Assessment* at: https://www.epa.gov/ports-initiative/national-port-strategy-assessment-reducing-air-pollution-and-greenhouse-gases-us.

Strategies and scenarios are effective to reduce on-port emissions

To evaluate the effectiveness of various strategies, EPA's analysis explored the potential of hypothetical scenarios, applied at different levels of implementation, to reduce future year emissions.

Figure ES-3 highlights potential NOx reductions for a selection of on-port strategies, including:

- **OGVs**: Use LNG in 5–10 percent of containerships
- **Harbor Craft**: Replace 20 percent of Tier 0 vessels with Tier 4 vessels
- **CHE**: Replace Tier 0 through Tier 3 equipment with Tier 4 or electric equipment
- **Trucks**: Limit on-port truck idling to 5 minutes per truck per visit

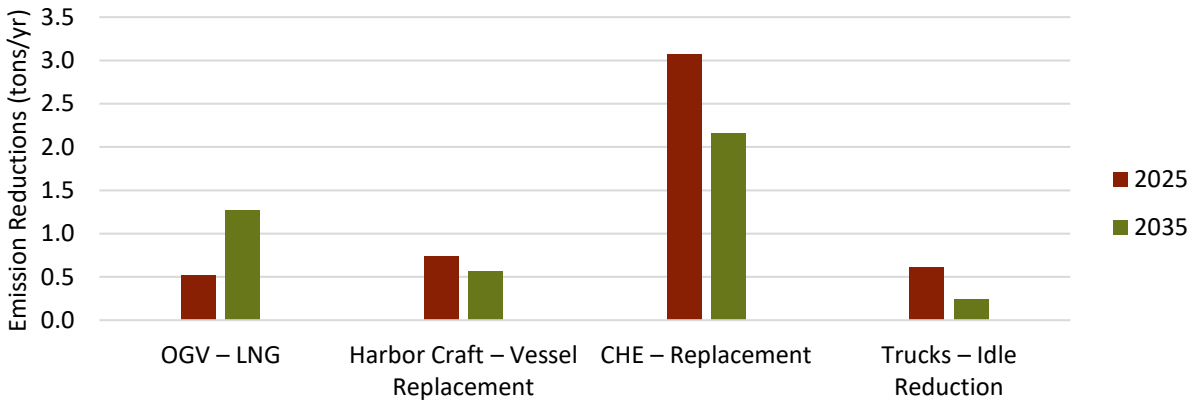


Figure ES-3. Projected Annual NOx Emission Reductions for Selected On-port Strategies

This chart illustrates that significant reductions are possible from these strategies, which are just a subset of the strategies examined in EPA's analysis for on-port emissions. A variety of strategies are available and ports can assess which make the most sense for their specific conditions. Note that the hypothetical scenarios[14] evaluated in this study do not include specific implementation details but assume coordination and collaboration by the various maritime industry stakeholders.

[14] In selecting scenarios, EPA qualitatively considered several factors, such as capital costs, market barriers, and potential for market penetration by analysis year. However, a detailed cost-benefit analysis was not conducted for this analysis and cost per ton of pollutant reduced was not calculated.

Potential actions can have benefits beyond a port's boundary

Ports are a nexus between transportation modes and activities that generate emissions at sea and on land, both on the port property and on nearby transportation corridors. As part of its analysis, EPA examined three transportation corridors to estimate emissions from port-related vessel and vehicle activity occurring outside Port Everglades. The off-port corridors included a marine corridor, a truck corridor, and a rail corridor.

For each corridor, EPA developed a 2015 off-port baseline inventory and projected future BAU emissions for the same years and pollutants as the on-port analysis. Hypothetical scenarios were also developed to examine potential strategies to reduce off-port emissions along transportation corridors. Figure ES-4 shows potential NOx reductions in 2025 and 2035 for a selection of off-port reduction strategies, including:

- **OGVs**: Have 50 percent of vessels participate in voluntary vessel speed reduction to 12 knots or less
- **OGVs**: Use LNG in 5–10 percent of containerships
- **Trucks**: Accelerate replacement of pre-2007 and pre-2010 trucks with model year 2010 or later trucks and some BEVs

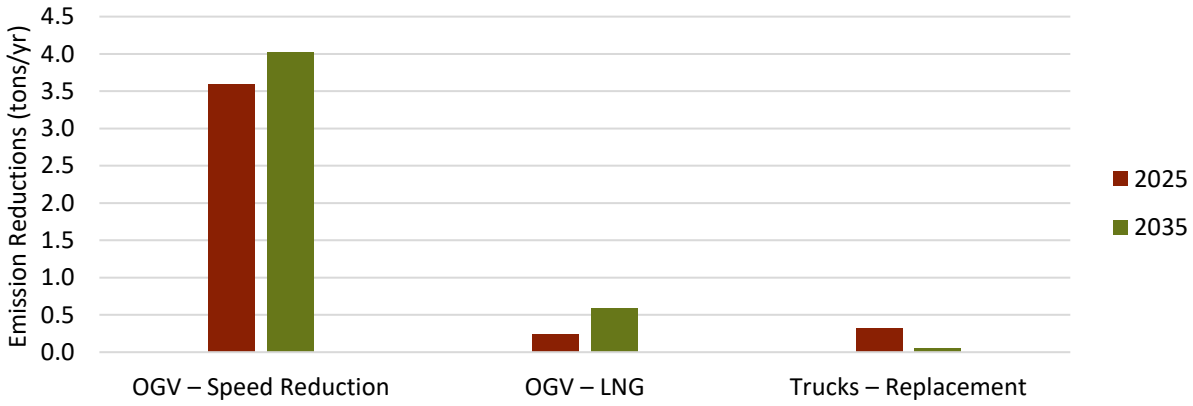


Figure ES-4. Projected Annual $PM_{2.5}$ Emission Reductions for Selected Off-port Strategies

Quantifying mobile source emissions using local data along these types of corridors can help stakeholders identify impacts and opportunities to reduce emissions.

Data and methods are available for developing port inventories and analyses

This partnership provided an opportunity to consider data and methods currently available for developing the emission inventories for port-related vehicle and equipment sectors. For each sector, inventories relied upon data describing the emission sources, such as vessel, equipment or vehicle type; engine type; horsepower; age; and other parameters. Activity and operational data, describing the amount of time and the circumstances in which the sources operate, were also used. These and other data are discussed throughout the report.

Emissions inventory resources

Emission estimation methods are currently available for all land and marine emission sources at ports. For OGVs, automatic identification system data from the U.S. Coast Guard were used to identify vessel movements in conjunction with Port Everglades' vessel call records. For harbor craft, information was collected about the type of craft and activity operating at the port. For locomotives, the Florida East Coast Railway, in consultation with Port Everglades, provided information on its locomotive fleet and operating characteristics. Additionally, EPA's MOtor Vehicle Emissions Simulator (i.e., MOVES2014a)[15] was used to model emissions from both onroad vehicles and nonroad CHE.

Partnering with Port Everglades allowed EPA to refine inventory development methods and will inform EPA's next update of the Port Emissions Inventory Guidance. Since the release of EPA's existing guidance in 2009,[16] additional information and methods have become available. For example, the MOVES model was not yet available when the existing guidance was issued, and its predecessor did not have the same capabilities. Lessons learned and methods developed from the EPA-Port Everglades partnership will be incorporated into EPA's updated guidance and will inform future inventory development and strategy analyses across the U.S.

[15] More information on EPA's MOVES model can be found at: https://www.epa.gov/moves.

[16] U.S. EPA, *Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories Final Report*, April 2009, https://www.epa.gov/moves/current-methodologies-preparing-mobile-source-port-related-emission-inventories-final-report.